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United States Department of Energy

Savannah River Site

Explanation of Significant Differences (ESD) to the Revision 1 Interim Record of Decision (IROD) for the TNX Area Operable Unit Groundwater (U)

WSRC-RP-2001-00764

Revision 0

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SRS

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Introduction

This Explanation of Significant Differences (ESD) is being issued by the U.S. Department of Energy (USDOE), the lead agency for the Savannah River Site (SRS) remedial activities, with concurrence by the U.S. Environmental Protection Agency (USEPA) – Region IV and the South Carolina Department of Health and Environmental Control (SCDHEC). The purpose of this ESD is to announce changes in the remedial decision selected in the *Interim Action Record of Decision, Remedial Alternative Selection - TNX Area Groundwater Operable Unit* (U), WSRC-TR-94-0375, Rev. 1, October 1994. The effective signature date of this Interim Action Record of Decision (IROD) is November 16, 1994.

The groundwater and vadose zone at the TNX Area Operable Unit (TNXOU) have been contaminated with volatile organic compounds (VOCs) as a result of past operations within the TNX Area. The remedy selected in the 1994 IROD to mitigate VOC contamination was the Hybrid Groundwater Correction Action (HGCA), which consisted of two treatment methods:

- Pump and treat system consisting of a recovery well network and a low-profile air stripper
- Airlift recirculation well

The recirculation well was later shown to be ineffective and the IROD was modified in 1997 to remove it from the HGCA system.

The performance of the interim action (IA) system is evaluated through an effectiveness monitoring program. The reporting requirements for this program specify that SRS is required to submit semi-annual monitoring reports to EPA and SCDHEC for the duration of the IA. The first report, known as the *TNX Area Groundwater and Effectiveness Monitoring Strategy Data Only Report* (Data Only Report), includes data collected during the first two quarters of each calendar year. The second report, known as the *Comprehensive TNX Area Annual Groundwater and Effectiveness Monitoring Strategy Report* (Annual Monitoring Report), is compiled six months later and includes data collected during all four quarters of the calendar year and a comprehensive evaluation of the IA effectiveness. During the first few years of IA operation, semi-annual reporting provided frequent updates on IA effectiveness.

Since start-up in 1996, the IA has continued to perform effectively at containing the VOC plume and reducing contaminant mass in the groundwater. However, vadose zone VOC source material continues to impact the groundwater at concentrations above Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs). Following USEPA guidance, this source may be considered Principle Threat Source Material (PTSM) requiring treatment because it is highly mobile and is contaminating groundwater at concentrations that pose risk to human health (i.e., above MCLs). Based on results of a treatability study, soil vapor extraction (SVE) could significantly reduce the mass of this VOC PTSM.

This ESD documents the following modifications of the IROD for the TNXOU Groundwater:

- Addition of SVE to the IA HGCA system
- Modification of IA effectiveness monitoring reporting requirements from two semi-annual reports to one annual report

USEPA recognizes SVE in its Superfund Accelerated Cleanup Model as a presumptive remedy for VOC contaminated soil. SVE is cost effective, simple to implement, and can be performed in situ with little site disturbance in areas that are difficult to access with other technologies. Deployment of SVE in the vadose zone is expected to:

- Remove significant amounts of residual VOCs representing PTSM from the vadose zone
- Prevent further aquifer degradation
- Reduce future VOC groundwater concentrations

Based on the current extent and transport of groundwater VOC contamination at TNX, as well as the removal efficiency of the IA, the effectiveness of the IA is not expected to change significantly during a six month period (i.e., semi-annually). Modification of the IA effectiveness monitoring reporting requirements from two semi-annual reports to one annual report (i.e., discontinuation of the semi-annual Data Only Report) is appropriate at this time. These changes will minimize redundancy in performance data reporting and facilitate cost savings. The first and second quarter data of the effectiveness monitoring program will continue to be included in the Annual Monitoring Report for the duration of the IA.

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §117(c), SRS is required to publish an ESD whenever there is a significant change to a component of a remedy specified in an IROD. Sections 300.435(c)(2)(i) and 300.825(a)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) require the lead agency to provide an explanation of the differences and to make the information available to the public in the Administrative Record File and information repositories.

This ESD is part of the Administrative Record File and is available for public review during normal business hours at the following information repositories:

U.S. Department of Energy Public Reading Room Gregg-Graniteville Library University of South Carolina 171 University Parkway Aiken, SC 29801 (803) 641-3465	Reese Library Augusta State University 2100 Walton Way Augusta, GA 30910 (706) 737-1744
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Summary of Site History, Contamination Problems, and Selected Remedy

The TNX Area Operable Unit (TNXOU) is situated in the southwestern portion of SRS, approximately one quarter-mile east of the Savannah River (Figures 1 and 2). The TNXOU consists of four waste units: the Old TNX Seepage Basin (OTSB), New TNX Seepage Basin (NTSB); TNX Burying Ground; and the TNX Groundwater beneath the surface units (Figure 3).

This ESD documents Post-IROD changes to the current remedy selected for the TNX Groundwater. Discussion of site history and contamination at TNX will be focused on the VOC contamination within the vadose zone and groundwater. Additional information on site history and contamination for the TNXOU and its subunits can be found in the *RFI/RI Work Plan for TNX Area Operable Unit* (WSRC-RP-95-113 Rev. 1.8) and the *RCRA Facility Investigation/Remedial Investigation Report with Baseline Risk Assessment for the TNX Area Operable Unit* (RFI/RI/BRA) (WSRC-RP-96-00808 Rev. 1.2).

Site History

The TNX Area was a pilot-scale testing and evaluation facility that supported nuclear fuel and target manufacturing chemical processes and the Defense

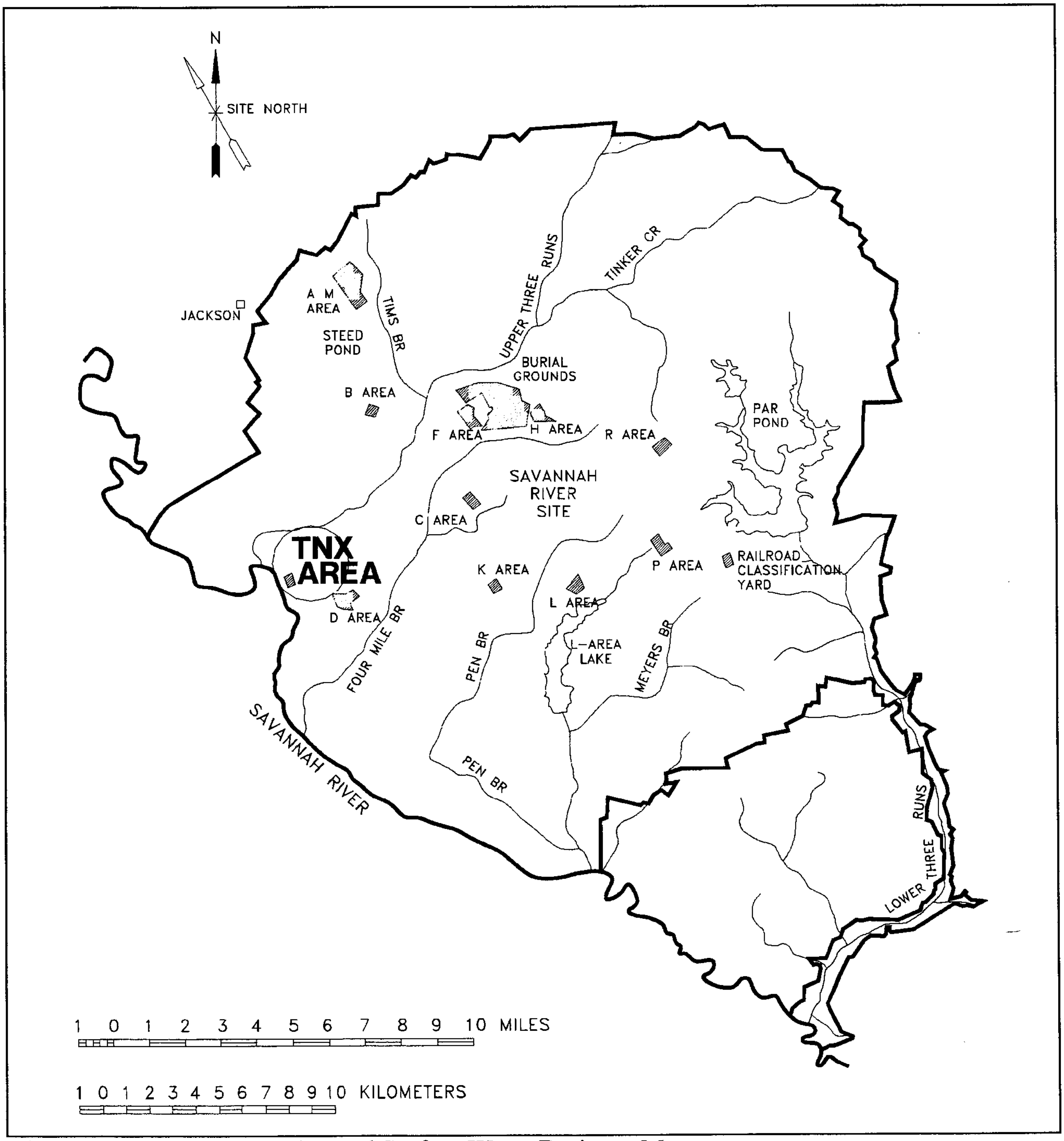

Figure 1. TNX-Area Location and Surface Water Drainage Map

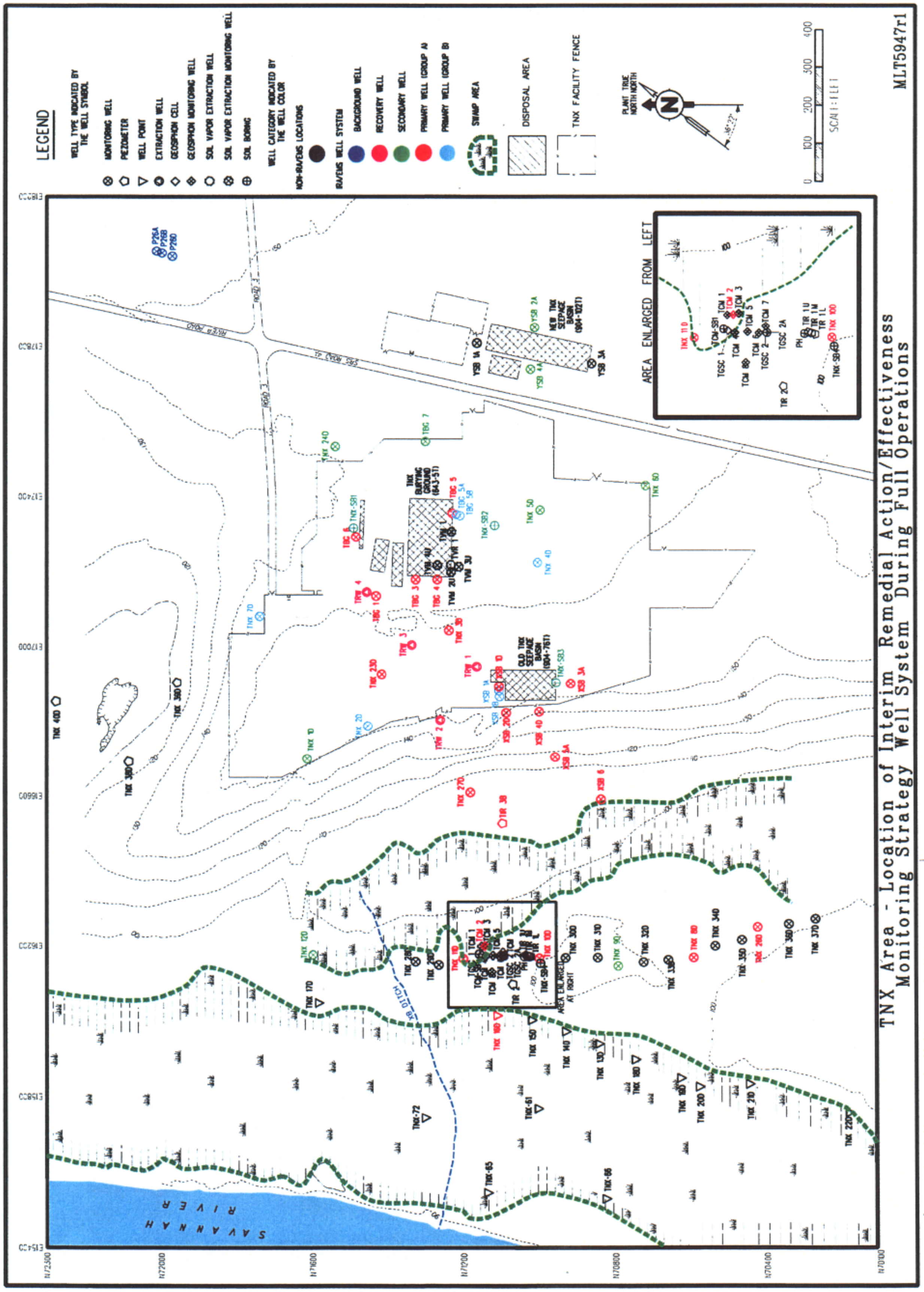

Figure 2. Location of Interim Remedial Action/Effectiveness Monitoring Strategy Well System

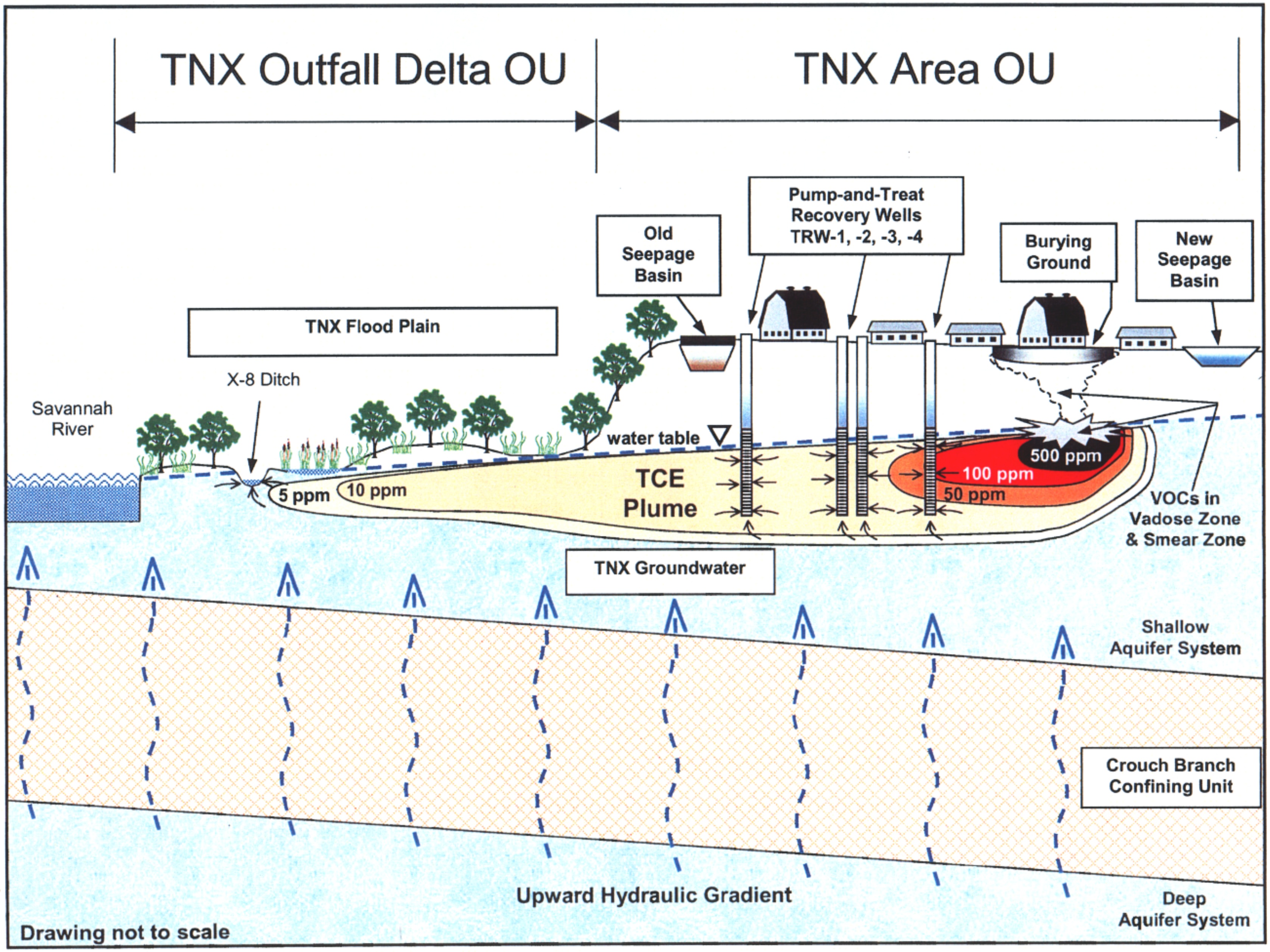

Figure 3. Schematic Cross Section of TNX Area Operable Units showing TCE Concentrations in Groundwater for Fourth Quarter 2000

Waste Processing Facility (DWPF). Past operations within the TNX Area resulted in contamination of the vadose zone and groundwater. Potential sources of groundwater contamination included seepage from unlined basins (OTSB, NTSB), leakage from the process sewers, leachate from contaminated media in the TNX Burying Ground, and leachate from other sources at TNX (e.g., a temporary storage facility for 55-gallon drums during the 1950s, and an equipment staging area).

The OTSB was an unlined liquid-waste disposal area that operated from the mid 1950's until 1980 and received radioactive organic and inorganic contaminated process wastewaters generated from TNX facilities. From 1981 to 1988, non-hazardous and non-radioactive process wastewater was sent to an unlined earthen basin known as the NTSB. In August 1988, the NTSB was removed from operation, at which time wastewaters were routed to the TNX Effluent Treatment Facility.

The TNX Burying Ground, which consisted of four trenches at 6- to 8-feet below land surface, received contaminated debris from a 1953 explosion of an experimental evaporator containing 1300 pounds of uranyl nitrate. Between 1982 and 1984, during an expansion of the TNX facilities, the majority of the buried waste was excavated and sent to the SRS Radioactive Waste Burial Ground. Five known areas and one suspect area of contamination were not excavated. These areas potentially contain an estimated 60 pounds of uranyl nitrate.

The TNX Groundwater is the groundwater beneath the TNX Area units described above and extending all the way to the Savannah River. Groundwater at TNX can be divided into two main aquifer systems, a shallow and deep aquifer system. The shallow system can be further subdivided into an upper unconfined water table aquifer (35 to 40 feet thick) that outcrops in the TNX floodplain and a lower semi-confined aquifer. Groundwater flows progressively from deep to shallow aquifers (i.e., upward hydraulic gradient) and to the Savannah River (WSRC-TR-98-48).

Contamination Problems

The nature and extent of contamination in soil, sediment, surface water, and groundwater at the TNXOU were characterized with the results summarized in the TNXOU RFI/RI/BRA. The only contamination likely to be encountered by the proposed SVE is the VOC contamination within the vadose zone beneath the TNX Burying Ground. Therefore, discussion of contamination will be focused only on the VOC contamination in the vadose zone and groundwater.

Groundwater VOC contamination consists primarily of trichloroethylene (TCE), and to a lesser extent, tetrachloroethylene (PCE) and carbon tetrachloride (CCl_4). The hydrogeological conditions at TNX have contained the VOCs to the water table aquifer, resulting in a plume extending from the TNX facility toward the adjacent floodplain and the Savannah River (Figures 3 and 4). VOCs have not been detected in the semi-confined or deep aquifers. TCE has been detected at the seep line in the TNX floodplain where the groundwater plume outcrops. However, no contaminants from the plume have been detected in the Savannah River or offsite groundwater.

Secondary source VOC contamination is present in the sediments within the vadose zone and uppermost portion of the water table beneath the TNX Burying Ground and continues to impact groundwater at concentrations above MCLs. Recent soil gas characterization has identified the approximate location of the vadose zone VOC source material.

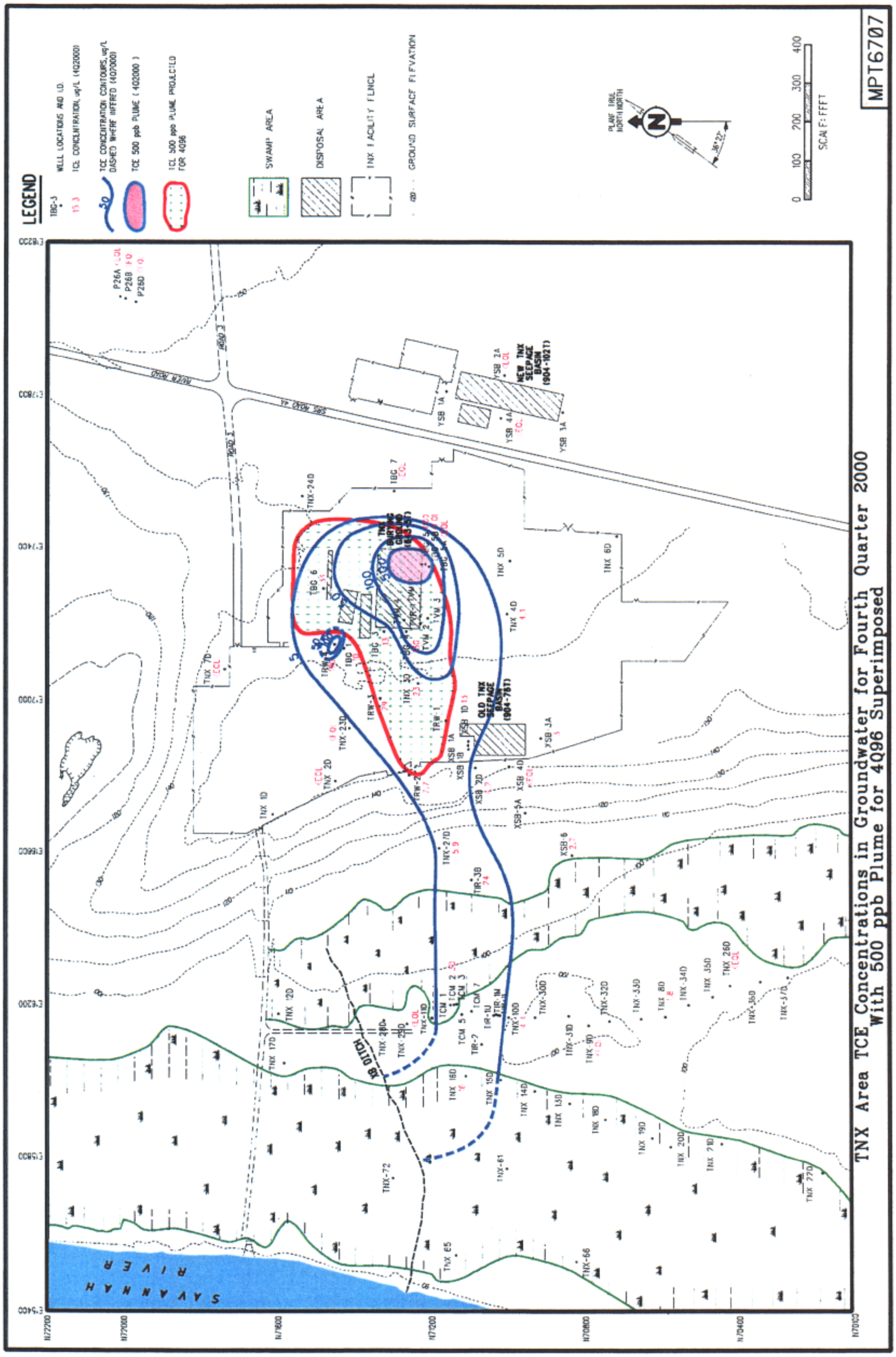

Figure 4. TNX Area TCE Concentrations in Groundwater for Fourth Quarter 2000

In addition, results from the SVE treatability study have identified a VOC "smear zone" of source material within the capillary fringe (15 feet above and below the water table) that likely resulted from leaching of vadose zone source material (WSRC-RP-99-0929). The lateral extent of the vadose zone and smear zone source material has not been fully determined, but appears to be within the area delineated by the 500 parts-per-billion (ppb) TCE groundwater plume contour (Figure 4). Following the USEPA guidance, *A Guide to Principal Threat and Low Level Threat Wastes* (OSWER 9380.3-06FS), this source material may be considered PTSM because it is highly mobile and is contaminating groundwater at concentrations that pose risk to human health (i.e., above MCLs). USEPA guidance places priority on treatment of PTSM, wherever practicable, with early actions favored.

WHAT IS PRINCIPAL THREAT SOURCE MATERIAL?

The NCP establishes an expectation that USEPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(ii)(A)). The "principle threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, to air, or acts as a source for direct exposure. Examples of source materials include drummed wastes, contaminated soil and debris, pools of dense non-aqueous phase liquids (NAPLs) submerged beneath groundwater or in fractured bedrock, NAPLs floating on groundwater, and contaminated sediments and sludges. Contaminated groundwater and surface water are not generally considered to be a source material. Principle threat source materials (PTSM) are those source materials considered to be highly toxic or mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. PTSM can include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds.

<u>Selected Remedy</u>

To control and remediate VOC source material and the groundwater plume, an IROD for the TNXOU Groundwater was authorized by USEPA, SCDHEC, and USDOE on November 16, 1994 (WSRC-TR-94-0375). The purpose of the IA was to serve as an incremental step in part of an overall remedy to address TNX groundwater contamination, but was not intended as a final remedy.

The following Interim Remedial Action Objectives (IRAOs) were developed:

- Prevent further aquifer degradation
- Maintain risk at acceptable levels to the onsite worker at the seep line
- Reduce potential risk to human health and the environment in general

To successfully achieve these IRAOs, the following Interim Remedial Goal Options (IRGOs) were agreed upon for the IA:

- Mitigate migration of VOCs to the floodplain by stabilizing the 500 ppb TCE plume core
- Remove VOC contamination in the groundwater near the TCE plume core

The IA is required to be operated and maintained for the period of time necessary to achieve the IRAOs and IRGOs or until a final response action is determined.

The remedy selected in the IROD to achieve the IRGOs was the HGCA. The HGCA consisted of two components: (1) a pump and treat system (recovery well network and low-profile air stripper) to treat and inhibit further migration of the 500 ppb TCE plume core, and (2) an airlift recirculation well, located at the heart of the plume to expedite remediation. Testing performed in 1996 demonstrated that the recirculation well system was ineffective in the TNX Burying

Ground area because of geological factors and the nature of the contamination. Furthermore, it was determined that the pump and treat system could adequately achieve the IRGOs. Consequently, the IROD was modified in 1997 with an ESD to discontinue operation of the recirculation well. Location of the current IA system and associated monitoring wells are presented in Figure 2.

Since start-up in 1996, the IA pump and treat system has continued to perform effectively at containing the 500 ppb TCE plume core, reducing transport of VOCs to the TNX floodplain, and reducing the overall contaminant mass in the groundwater. The recovery wells of the IA system are designed to feed the air stripper at a rate of 80 gallons per minute. Water table elevations and the estimated zone of capture associated with the system are presented in Figure 5. The extent of the groundwater TCE plume for the fourth quarter of 2000 is presented in Figure 4.

In addition to the IA pump and treat system, two treatability studies using other technologies (i.e., GeoSiphon™ Cell and SVE) were evaluated in the field for their effectiveness in removing VOCs from the groundwater or vadose zone, respectively.

The GeoSiphon Cell treatability study was conducted in the TNX floodplain to evaluate in situ treatment of VOC contaminated groundwater. The GeoSiphon Cell consisted of a large diameter well containing granular cast iron, which reduces chlorinated VOCs in groundwater to ethane, methane, and chloride ions. Results from the study demonstrated that the passive technology can successfully treat TCE contaminated groundwater from the TNX floodplain to concentrations below 5 ppb (WSRC-RP-2001-4138 Rev. 0). Based on these results, the GeoSiphon Cell technology will remain as a possible alternative option during final remedy selection for the TNX Groundwater. However, as a result of the continued effectiveness of the IA pump and treat system, floodplain VOC concentrations have decreased significantly. Consequently, deployment of several GeoSiphon Cells in the floodplain may not be the most effective or cost efficient alternative at reducing the mass of VOC contamination at TNX and minimizing future VOC groundwater concentrations in the TNX floodplain.

The SVE treatability study was performed in the vadose zone near the TNX Burying Ground in 1997 (Phase I) and in 1999 (Phase II) (WSRC-TR-97-0336, WSRC-TR-99-51). During a 180 day period of intermittent operation, a very small scale SVE unit was able to remove 18 pounds of TCE and 8 pounds of CCl_4 (pumping rates between 5 and 20 cubic feet per minute with an estimated radius of influence between 40 and 110 feet). Based on these results, addition of SVE to the current IA should be an effective and cost efficient approach at reducing the mass of VOCs at TNX (i.e., removing vadose zone secondary source VOCs near the plume core) and minimizing future VOC groundwater concentrations in the TNX floodplain.

Description of Significant Differences and the Basis for those Differences

The purpose of this ESD is to document Post-IROD changes to the current IA remedy selected for the TNX Groundwater. The current IA remedy is the HGCA system, which consists of a pump and treat system (recovery well network and low-profile air stripper). The effectiveness of the IA HGCA system is reported semi-annually.

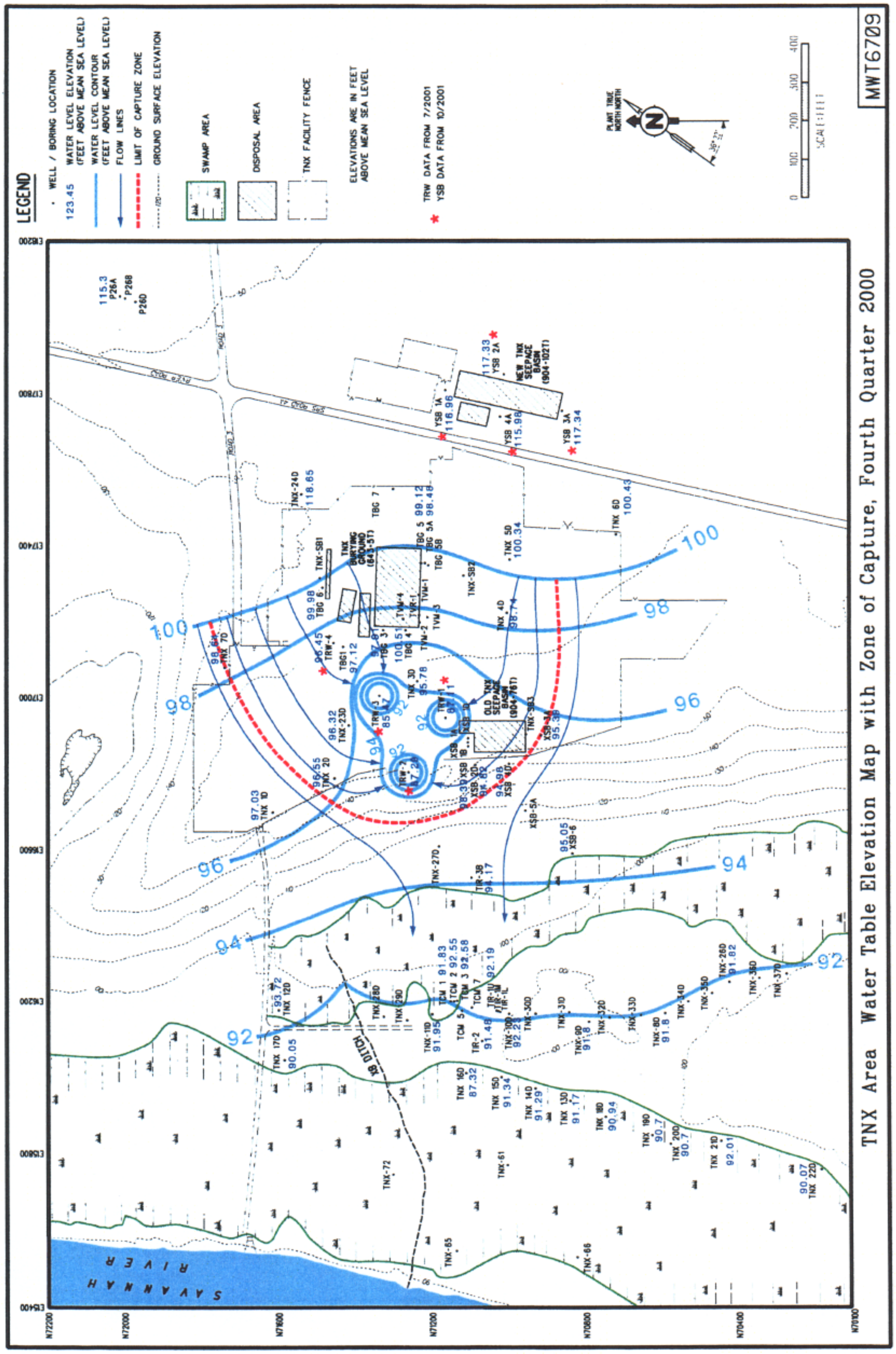

Figure 5. TNX Area Water Table Elevations with Zone of Capture for Fourth Quarter 2000

The significant differences of the modified remedy from the current remedy are:

- Addition of SVE to the IA HGCA system
- Modification of IA effectiveness monitoring reporting requirements from two semi-annual reports to one annual report

Soil Vapor Extraction

SVE has been recognized by the USEPA as a presumptive remedy for remediation of sediments contaminated with VOCs. The technology is cost effective, relatively simple to implement, and can be performed in situ with little site disturbance in areas that are difficult to access. SVE physically removes VOCs from the vadose zone by vacuum extraction of soil gas. The extraction wells used in the process are drilled through the contaminated vadose zone soil to just above the water table. During operation, SVE induces air flow through the soil matrix, which strips VOCs from the soil and carries them to the extraction wells. The vapors are processed through a liquid-phase separator and either released to the atmosphere in accordance with SCDHEC and USEPA requirements or treated to control emissions.

As discussed earlier, SVE can remove significant amounts of VOCs from the vadose zone beneath the TNX Burying Ground in a short period of time. In order to protect human health and the environment from future releases of VOCs into groundwater above MCLs, addition of SVE to the current IA remedy is proceeding at this time. SVE can be implemented quickly under the existing interim action framework and satisfies the statutory preference for treatment of PTSM (NCP §300.430(a)(1)(ii)(A), CERCLA §121). Extracting the VOC source material before it leaches to groundwater will help minimize future VOC concentrations in the groundwater and potentially reduce the total time required for groundwater remediation. Employment of SVE is expected to achieve the following IRAOs:

- Remove significant amounts of residual VOCs representing PTSM from the vadose zone
- Prevent further aquifer degradation
- Reduce future VOC groundwater concentrations

Recent vadose zone characterization indicates that the mass of VOC source material is relatively small. Deployment of a portable SVE system may be the most effective and cost efficient approach for achieving the above IRAOs. Therefore, during the initial implementation of SVE, a portable SVE unit will be evaluated.

Prior to implementing SVE, characterization borings will be required to better define the lithology and contamination profile within the suspected source area. The information will be used to support the design of the SVE system, including specifications for extraction and monitoring well placement and screen intervals. During construction and start-up of the IA SVE system, testing will be performed to confirm proper system function and operation. System optimization will then be performed during the initial phase of operation (3-4 months) to establish baseline parameters (i.e., removal rates, etc.) and develop operating procedures.

SVE will be performed using several extraction wells simultaneously in the vicinity of the plume core in a manner that maximizes VOC removal and minimizes operational costs. It is anticipated that the SVE system will be operated until remediation has reached a point of diminishing returns, where passive remediation (i.e., natural barometric pumping) is as effective as active remediation. Remediation effectiveness will be determined by evaluating the (1) rate of mass removal, (2) system response following restart, and (3) cost of operation. An assessment of these combined criteria will be used to determine when it is appropriate to begin easing operations. A monthly mass removal that is 1/10th that of the initial monthly mass removal at startup is an indication that active remediation is approaching the point of diminishing returns and passive remediation may be more appropriate. Because the mass of VOC source material may be relatively small, it is anticipated that active SVE will reach this point within a 6 to 18 month period.

Performance monitoring of the SVE system will be performed monthly during initial operation and quarterly during normal operation. The information obtained during performance monitoring will be evaluated and reported annually in the existing Annual Monitoring Report for the TNX Groundwater IA system. Performance reviews will be conducted during the normal operation to make modifications to design parameters, well locations, etc. Additional monitoring wells may be installed to support refinement of the remediation process.

A portable SVE system was the remedial alternative with the lowest overall cost evaluated in the *Corrective Measures Study/Feasibility Study for the TNX-Area Operable Unit* (CMS/FS) (WSRC-RP-97-428 Rev. 1) for VOC contamination in the vadose zone. The total, present worth cost for this system and associated activities was estimated in the CMS/FS to be $1,119,000 ($439,000 in capital costs, $626,000 operation and maintenance costs, 7% discount rate). This conservative estimate assumes that complete remediation of the vadose zone can be accomplished within a five year operating period (2 years active SVE, 3 years passive SVE) and includes costs associated with VOC emission treatment using activated carbon, performance monitoring and reporting activities, and a five year remedy review.

Effectiveness Monitoring Strategy

The effectiveness of the current IA has been assessed quarterly by a monitoring program as required by the TNX Effectiveness Monitoring Strategy of the *TNX Groundwater Operable Unit Remedial Design Report/Remedial Action Work Plan* (WSRC-TR-95-0284 Rev. 1.5). The reporting requirements for this program specify that SRS is required to submit semi-annual monitoring reports to EPA and SCDHEC for the duration of the IA. The first report (i.e., Data Only Report) includes data collected during the first two quarters of each calendar year. The second report (i.e., Annual Monitoring Report) is compiled six months later and includes data collected during all four quarters of the calendar year and a comprehensive evaluation of the IA effectiveness. The evaluation includes ground-water quality changes, TCE plume maps, time-trending concentration data, water elevations and drawdowns, precipitation data, and operational history during the calendar year. During the first few years of operation, semi-annual reporting provided frequent updates on the IA effectiveness.

Since start-up in 1996, the IA has effectively contained the VOC plume and reduced contaminant mass in the groundwater. Based on the current extent and transport of groundwater VOC contamination at TNX and as well as the removal efficiency of the IA, the IA effectiveness is not expected to change significantly during a six month period (i.e., semi-annually). Modification of the IA effectiveness monitoring reporting requirements from two semi-annual reports to one annual report (i.e., discontinuation of Data Only Report) is appropriate at this time. These changes will minimize redundancy in performance data reporting and facilitate cost savings. The first and second quarter data of the Data Only Report will continue to be included in the Annual Monitoring Report for the remaining IA duration.

The above changes in reporting requirements, as well as SVE design specifications, construction strategy, operations and maintenance plan/requirements, and performance standards will be documented as page changes in a revision to the *TNX Groundwater Operable Unit Remedial Design Report/Remedial Action Work Plan.* A final design and construction summary for the SVE system will be documented as page changes in a revision to the *Post Construction Report for the TNX Groundwater Operable Unit Interim Remedial Action* (WSRC-RP-96-0826 Rev. 1).

Statutory Determinations

The modified remedy meets the requirements specified in CERCLA Section 121 to: (1) be protective of human health and the environment; (2) comply with (or waive) applicable or relevant and appropriate requirements (ARARs); (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element of the remedy which permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants.

An ARAR waiver under §300.430(f)(1)(ii)(C) of the NCP for all groundwater constituents of concern (COCs) has been invoked because this remedy is an interim action measure that will become part of a total remedial action that will ultimately attain ARARs. Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Because the remedy is part of an interim action, review of the TNXOU and this remedy will continue as USDOE develops remedial alternatives for the TNXOU Groundwater.

Public Participation Activities

An SRS RCRA permit modification is not required at this time since this remedy is a modification to an existing interim action. However, the final permit modification will (1) include the final selection of remedial alternatives under RCRA, (2) be sought for the entire TNXOU Groundwater with the final Statement of Basis/Proposed Plan (SB/PP), and (3) will include the necessary public involvement and regulatory approvals. The IROD also satisfies RCRA requirements for an Interim Measures Work Plan.

The public will be notified of this ESD and a 20-day public comment period through mailing of the *SRS Environmental Bulletin,* a newsletter sent to approximately 3,500 citizens in South Carolina and Georgia, and through notices in the *Aiken Standard,* the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People Sentinel,* and *The State* newspapers. Local radio stations will also announce the public comment period. To obtain more information or to submit comments contact:

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